DOCK-TO-DOCK RECEIVING AND DISPENSING FOR POSTAL PROCESSING CENTER

BACKGROUND OF THE INVENTION

The present invention is directed to a postal processing facility such as the type which processes letter mail, flat mail, such as magazines, and the like, such as by sorting mail by zip code or some other convenient index. More particularly, the invention relates to the dispatching of trays of sorted mail from a sorting system to transportation fixtures and the unloading of trays of mail to be sorted from transportation fixtures to the sorting system.

A conventional integrated processing facility 10, such as shown in figure 1, includes an unloading system 12, which unloads trays, each of which contains incoming letters, flat mail, or the like, from transportation fixtures, such as ERMCS rolling carts, or pallets, or the like, and inducts the containers to a Tray Management System (TMS) which feeds the trays to the remaining portion of the mail-sorting system generally illustrated at 14. Integrated processing facility 10 additionally includes a loading system 16 which receives trays of letters, flat mail, and the like, from mail-sorting system 14 via the TMS and loads the letter trays to the transportation fixtures; namely, carts, pallets, or the like. In the illustrated embodiment, loading system 16 may be of the general type disclosed in figure 1 of commonly assigned Patent Cooperation Treaty (PCT) patent application Serial No. PCT/EP99/00317 filed January 21, 1999, the disclosure of which is hereby incorporated herein by reference. Unloading system 12 may be of the type illustrated in figure 2 of said PCT patent application.

As can be seen by reference to figure 1, loading system 16 and unloading system 12 are positioned in an interior portion of integrated processing facility 10. The transportation fixtures are received from vehicles, such as semitrailer trucks, at a

loading dock (not shown) which is, by necessity, positioned at a peripheral portion of facility 10. Because the loading dock is at a peripheral portion of facility 10 and loading system 16, and unloading system 12 is at an interior portion of facility 10, it is necessary to transport the transportation fixtures a significant distance between the loading system 16, unloading system 12, and the loading dock. This has traditionally been carried out by manual movement of the carts and forklift transportation of pallets. Recently, it has been suggested to use Automatic-Guided Vehicles (AGVs) to move the transportation fixtures between the loading dock, loading system 16 and unloading system 12. This transportation creates additional processing time and capital expenditures, thereby adding to the cost of mail processing. Furthermore, such prior art processing facility is inefficient in equipment utilization. Trucks with incoming mail would be positioned at a dock space relatively close to unloading system 12 in order to deliver incoming trays and then be repositioned at another dock space closer to loading system 16 in order to receive outgoing mail. Furthermore, unloading system 12 is utilized during a relatively short period of time as illustrated by the portion designated "RCS Dispatch Only" in figure 11. Likewise, loading system 16 is utilized only during a relatively small portion of the schedule indicated by "outgoing mail volume" in figure 11. Accordingly, equipment utilization both within facility 10 and adjunct to facility 10 is relatively low.

SUMMARY OF THE INVENTION

The present invention provides a postal processing facility receiving and dispatch system that eliminates the necessity for unloading to and dispatching from internal portions of the facility. The present invention furthermore combines the use of equipment in a manner that utilizes the equipment throughout the processing day. The present invention also eliminates the necessity for dedicated input doors and output doors at the loading dock. Therefore, trucks do not need to be moved between input doors and output doors, thereby simplifying the handling of trucks in the yard.

These and other objects, advantages, and features of this invention will become apparent upon review of the following specification in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top plan view of an integrated processing facility provided by the prior art;
Fig. 2 is a top plan view of an integrated processing facility according to the invention;
Fig. 3 is an enlarged portion of the area indicated by III in Fig. 2;
Figs. 4a and 4b are illustrations of a process for loading and unloading trays of mail between a vehicle and a sorting system according to the invention;
Fig. 5 is a top plan view of the area indicated by V in Fig. 3;
Fig. 6 is a side elevation of the view indicated by VI-VI in Fig. 5;
Fig. 7 is a sectional view taken along the lines VII-VII in Fig. 5;
Fig. 8 is a side elevation of the lifter mechanism in Fig. 7;
Fig. 9 is a sectional view taken along the lines IX-IX in Fig. 5;
Fig. 10 is a perspective view of the robot in Fig. 9; and
Fig. 11 is a diagram illustrating daily mail volume in an integrated processing facility.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now specifically to the drawings, and the illustrative embodiments depicted therein, a postal processing system 20 includes a building 22 having a loading dock 24 which, as is traditional, includes a plurality of loading doors and another traditional dock facility (not shown) to accommodate vehicles 26 which, in the illustrated embodiment, are semitrailer trucks. Alternatively, vehicles 26 could be train cars, vans, or the like. As is conventional, postal processing facility 20 includes a mail-sorting system 28, including a Tray Management System (TMS) 30, which conveys and sorts trays between a series of mail-sorting machines, generally shown at 32.

Postal processing facility 20 additionally includes a receiving and dispatching system 34 that loads trays of sorted mail from TMS 30 to transportation fixtures, such as ERMCS carts, pallets, or the like, and unloads trays of mail to be sorted from

transportation fixtures to TMS 30. Receiving and dispatching system 34 is made up of a plurality of receiving and dispatching cells 36, each of which is interconnected with a sortation conveyor 38, as will be described in more detail below. Each receiving and dispensing cell 36 is capable of loading trays of sorted mail to transportation fixtures and unloading trays of mail from transportation fixtures. This eliminates the necessity for separate loading systems and unloading systems which, as previously set forth, are poorly utilized throughout the processing day. Advantageously, receiving and dispensing cells 36 are at loading dock 24. This eliminates the necessity for a transportation system to transport the transportation fixtures between the loading dock and an interior portion of the processing facility. Furthermore, each vehicle 26 may remain positioned at a single loading/unloading door with transportation fixtures removed from the vehicle, the trays of sorted mail removed from the transportation fixtures, the trays of sorted mail loaded to transportation fixtures, and the transportation fixtures loaded to the vehicle 26 without having to move the vehicle 26 between an unloading door and a separate loading door.

Receiving and dispatching cell 36 includes a sortation conveyor 38 having a main line 40 which, preferably, is a recirculating continuous loop (Fig. 5). A plurality of spurs 42 extend from main line 40 to a receiving and dispatching assembly 44. Sortation conveyor 38 is elevated with respect to each receiving and dispatching assembly 44 wherein trays are lowered from sortation conveyor 38 by a mechanism, such as a gravity chute 46 (Fig. 6).

Each receiving end dispatching assembly 44 includes a plurality of cart positioners 48 and a transport mechanism 50 for transporting mail trays between spur 42 and each cart positioner 48. Spur 42 includes a powered roller conveyor 52 which extends the length of receiving and dispatching assembly 44. In the illustrated embodiment, transportation mechanism 50 is a robot of the type manufactured by Fanuc products under Model M710i. It should be understood that transport mechanism 50 could alternatively be of the type disclosed in PCT patent application Serial No. PCT/EP99/00317 filed January 21, 1999, for a HIGH THROUGHPUT DISPATCH SYSTEM FOR MAIL PROCESSING AND DISTRIBUTION SYSTEM, the disclosure of

which is hereby incorporated herein by reference, suitably modified to be capable of unloading carts as well as loading carts. Preferably, receiving and dispatching assembly 44 is enclosed with an enclosure 54, such as a fence, in order to keep personnel from the operation of transport mechanism 50. Enclosure 54 includes a moveable gate 56 at each cart positioner 48 which can be selectively opened to allow transportation fixtures to be loaded or unloaded to the receiving and dispatching assembly 44. Advantageously, this arrangement allows receiving and dispatching system 34 to continue to operate even though a particular receiving and dispatching cell is having a cart replaced because only one cell is locked out at a time.

Powered roller conveyor 52 includes a lift mechanism 58 at strategic locations along the powered roller conveyor. Lift mechanism 58 (Fig. 7) includes a plurality of support fingers 60 which are selectively elevated by a lift assembly 62 when a tray is positioned over the lift mechanism. A pair of positioning arms 64 serve to center the tray over the lift mechanism. When lift mechanism 58 is actuated, the tray is elevated in order to allow transport mechanism 50 to engage the tray from either a lateral side direction or an end longitudinal direction. This allows the transport mechanism to position each tray 73 328on a cart in either of two orthogonally related positions. This allows trays to be staggered on the cart in alternating patterns in order to increase security of cart loading. Receiving and dispatching assembly 44 additionally includes a half tray support 66 adjacent cart positioner 48. This provides a staging area for transport mechanism 50 to position half trays during the loading of a cart. If transport mechanism 50 comes across another half tray, then the two half trays can be positioned together in order to provide the same profile as a full tray. This avoids any instability caused by the placement of a half tray on a cart.

In the illustrative embodiment, transport mechanism 50 includes a robot arm 70 which terminates in an end-effector, or an end-of-arm tool, 72. Transport mechanism 50 additionally includes a transporter 82 having legs which span powered roller conveyor 52 and any mail tray on the powered roller conveyor 52. End-effector 72 includes a tray support in the form of a series of tines 74 and a clamp member 76 for clamping a tray against the tray support 74. Endeffector 72 additionally includes a pusher/grabber

mechanism 78 which pushes trays from tray support 74 concurrently with end effector 72 being withdrawn from the cart. Alternatively, pusher/grabber 78 engages a hand opening (not shown) in the side of a tray in order to pull a tray onto tray support 74. In order to facilitate the loading and unloading of trays onto tray support 74, one or more, preferably two or more, sensors, such as imaging sensors 80, are positioned on the end of tray support 74.

Receiving and dispensing system 34 operates as follows. In order to load trays of sorted mail to transportation fixtures, trays are diverted onto spur 42 by a diverter, such as a conventional pop-up rotating-belt diverter or the like, and travel down chute 46 under gravity. The tray is transported by powered roller conveyor 52 to an appropriate position for transporting by transport mechanism 50. This is accomplished by lift mechanism 58 elevating the tray and end-effector 72 of transport mechanism 50 engaging the tray from the appropriate direction according to the need of the cart being loaded. The tray is grasped between clamp mechanism 76 and tray support 74 and is positioned on the appropriate cart. This may be accomplished by transporter 82 traveling in the direction of conveyor 52. As previously set forth, trays are loaded onto carts utilizing pusher/grabber 78 to strip the tray from tray support 74. When a cart is full, the associated gate 56 is opened which shuts down the respective cell 36 while that cart is loaded onto a vehicle 26 located at an adjacent door. The cart is replaced with an empty cart and gate 56 is closed allowing the respective cell to resume operation.

In a mode in which trays are unloaded from transportation fixtures, the full fixture is positioned on a cart positioner 48 and gate 56 is closed. Transport mechanism 50 causes endeffector 72 to individually engage the trays on the cart to be unloaded. Pusher/grabber 78 is extended under the guidance of imaging sensors 80 into engagement with an opening in the side of the tray. The pusher/grabber 78 is retracted pulling the tray onto tray support 74. Clamp member 76 clamps the tray against tray support 74. Transport mechanism 50 places the cart on lift mechanism 58 in the proper orientation. Lift mechanism 58 retracts causing the tray to be properly positioned on powered roller conveyor 52. Powered roller conveyor 52 includes a powered incline

portion 52a which conveys the unloaded tray onto TMS 30 by conveying the tray uphill onto a receiving portion of sortation conveyor 38. Alternatively, it would be possible to have chute 46 replaced with a powered roller conveyor that is capable of operation in both directions such that trays being unloaded are transported upwardly away from the respective receiving and dispatching assembly. The rollers are reversed and the conveyor transported in the opposite direction to receive trays for loading onto the carts.

As can be seen by references to figures 4a and 4b, the invention can be utilized in different ways to dispatch and receive trays. Figure 4a shows three receiving and displaying cells 36 designated 1, 2, and 3. In this example, cell 1 is full of carts received from a vehicle, cell 2 is full of empty carts and cell 3 is full of carts ready for dispatch. As the carts are unloaded in cell 3, they are available for use in cell 2 which then becomes a receiving cell. As full receiving carts are removed from cell 1, they can then become a dispatch cell and replaced with full carts for dispatching. Figure 4b shows an alternative method in which individual positions within each of the cells 1, 2, and 3 are utilized as either receiving positions, dispatch positions, or empty positions. Because of the capability of the computer system (not shown) controlling the receiving and dispatching system, the function of each cart position can be determined and monitored.

As can be seen in figure 11, the present invention provides a receiving and dispatching system which is more fully utilized throughout the processing day thereby ensuring a more effective return on investment. During period A, mail is received from the trucks and processed by mail-sorting system 28. During period B, the processed mail is dispatched utilizing receiving and dispatching system 34. During period C, mail which arrives occasionally on vehicles 26 can be received as it arrives. Any remaining mail is dispatched at D.